

Pioneer Mission Support

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This article covers the time period from 1 January 1978 through 31 May 1978. Ongoing Pioneer Project operations (Pioneers 6 through 11) are briefly mentioned. The DSN prelaunch preparations and launch operations for the Pioneer Venus Orbiter are described in detail, along with a brief update on the Pioneer Venus Multiprobe launch and encounter preparations.

I. Pioneers 6, 7, 8, 9, 10, 11

Pioneers 6-9 have only been tracked on a few rare occasions, due to the higher priority of other DSN users, and all the spacecrafts' status appear to be unchanged. Pioneer 10 and 11 are being tracked almost daily; Pioneer 10 mostly by DSS 63, and Pioneer 11 mostly by DSS 42 and DSS 62. Precession maneuvers on Pioneer 10 and 11 are routinely being conducted approximately every four weeks.

II. Pioneer 12 (Pioneer Venus Orbiter)

A. Prelaunch Training and Testing for Launch and Cruise

The DSN prelaunch test and training program was planned to follow the established sequence of:

- (1) Start DSN Operational Verification Tests (OVTs) (on 1 Oct. 1977)
- (2) Start support of ARC Ground Data System (GDS) tests (on 1 Nov. 1977)

- (3) Start support of MOS Operational tests (in January 1978)
- (4) Start DSN Initial Acquisition tests at launch minus 30 days
- (5) Support prelaunch Operational Readiness Tests (ORTs).

The initial DSN OVTs uncovered some problems such as the inability of the Telemetry Processor Assembly (TPA) to process Pioneer Venus uncoded telemetry, and several station and NOCC problems associated with the newly implemented high-speed data 22-bit error polynomial. These problems were discussed in detail in *The DSN Progress Report 42-45* (Pioneer Venus 1978 Mission Support for April 1978).

The above problems delayed the DSN readiness for GDS support by approximately one month; however, the principal obstacle in preparing for the Orbiter launch was severe problems with the ARC simulation, telemetry, and command software. To expedite the development of the ARC software a series of single system "data flow" tests were initiated in January 1978, occasionally supported by DSS 11, 44, 62 and

MIL-71; but the bulk of these numerous tests were conducted between ARC and CTA-21.

The DSN OVT schedule was also extended to keep the DSS crew proficiency at an acceptable level, and these added OVTs were also utilized as a data source to provide ARC with opportunities to further develop their telemetry and command software.

Formal GDS tests started on 1 March 1978 and MOS tests on 20 March 1978, and the ORTs in May 1978, with no significant DSN problems.

B. Pioneer Venus Orbiter Launch

- (1) The Pioneer Venus Orbiter Initial Acquisition study was published and sent to the Pioneer Acquisition station (DSS 44) and the back-up station (DSS 42) on 15 April 1978 prior to the Initial Acquisition OVTs. The Initial Acquisition OVTs were conducted successfully, with both stations confirming that station and JPL crews scheduled to support the launch were fully trained.
- (2) All DSN launch-required facilities were green prior to launch. There was, however, a major antenna failure during a rain storm at DSS 44, with repairs completed only 24 hours prior to launch.
- (3) Predicts had to be regenerated at L-20 minutes due to a 5 kHz change in predicted frequencies supplied by Ames.
- (4) After a reasonably smooth minus count the Atlas Centaur lifted off at 13:13:00.073 GMT. The launch to parking orbit was nominal with Main Engine Cutoff (MECO) 1 occurring 7.4 seconds before predicted time. The Centaur second burn was nominal with MECO 2 and spacecraft separation occurring 4.5 seconds before predicted time. Spacecraft injection appeared to be very nominal with midcourse correction calculations from preliminary data calculated to be about 3 meters per second.
- (5) During the minus count only two communication problems of any significance occurred. The spacecraft telemetry 7.2 kilobit/s HSD line was down for 24 minutes which caused the Project to reschedule a command memory readout. The ACN 6.2 kilobit/s spacecraft data line to the Cape was red for 8 minutes.
- (6) During the plus count all ETR, STDN, and ARIA supported all data intervals essentially as planned. No major losses of data occurred. Mark events 1 through 13 were read out.

- (7) ACN support for possible commanding was flawless, however, the PMOCC elected to not send the command to start the science sequence because of ambiguous telemetry indications. This was the most significant post-launch problem and first became apparent when processing the post-separation ACN data by the PMOCC showed a tremendous number of spacecraft problems. At the same time the Hughes computer at the Cape, processing supposedly the same data, showed all was well on the spacecraft. This ambiguity in the spacecraft status caused the Project to not send the command from ACN to start the science sequence. The first DSS 44 data processed by the PMOCC showed all was well and the science sequence was started from that station.

This discrepancy in processing of ACN data was caused by an error in the high-speed data system Block Error Decoders (BED) located at Ames and was not isolated until one month after launch. The BEDs were relabeling high-speed data blocks found to have errors as error-free blocks.

- (8) The initial acquisitions by DSS 44 and 42 were textbook except for a momentary loss at the backup station (DSS 42) when the antenna ran into the DEC prelimits during autotrack on the acquisition aid antenna. DSS 44 acquired the uplink with only 5 Hz left of the planned uplink sweep at VCO level.
- (9) The only anomaly during the first pass was an indication of the spacecraft rejecting a ground command that was never sent after DSS 62 AOS. This anomaly was later determined to have been caused by excessive radiated transmitter power causing the command detector (CMD) to interpret noise as a command. This CMD was then rejected due to checksum errors. DSS 44 radiated 500 watts (SCM) during the initial acquisition pass and DSS 62 acquired at 1 kW as planned. Subsequent to the above diagnosis, uplink power was reduced to 300 watts at all stations until launch plus 2 days when the power was increased (over DSS 11) to 1 kW.

Magnetometer boom deployment, first precision maneuver, and high gain antenna spin-up were supported without incident. Extensive science calibration related activities have also been continuing.

- (10) Two other major events after launch were the Trajectory Correction maneuver on 1 June and the first attempt at executing the High Gain Antenna and X-band calibration over DSS 11 and 14 on 8 and 9 June. The X-band downlink signal level was 10 dB lower than expected. Subsequent testing showed the loss was due to bandwidth spreading resulting from

the uplink command modulation being turned around into the X-band.

Although this report has concentrated on problems encountered, the overall launch support was considered very successful and the view has been generally expressed that this was the smoothest planetary launch to date.

III. Pioneer Venus Multiprobe

A. Launch Preparation

The Multiprobe launch preparation is a relatively small task compared to the Orbiter launch, as the stations involved are tracking the Orbiter daily and both spacecraft are very similar in the launch/cruise mode as far as the DSN is concerned.

The only DSN tests planned are initial acquisition OVTs with DSS 42 and 44; and support of a single MOS test on 12 July 1978; and two ORTs on 27 July and 2 August respectively.

The only change from the Orbiter launch is that DSS 42 will be prime, with DSS 44 as back up. The reason for this is that the spacecraft will rise and set in the DSS 44 West "Keyhole" resulting in the DSS 42 rise earlier than DSS 44 and also resulting in DSS 42 setting approximately one hour ten minutes later than DSS 44, permitting an overlap with DSS 62.

B. Multiprobe Entry Planning

As a result of the four 8-hour Multiprobe Entry procedure development tests in March 1978 (discussed in *The DSN Progress Report 42-45*) conducted at DSS 14, the following procedures have been generated and will be used in the remaining Multiprobe Entry preparation activities:

- (1) A detailed step-by-step sequence of events covering the entire Multiprobe Entry portion of the mission was developed.
- (2) A first cut at an E-3 hour checklist (E = time of entry of the probes into the Venus atmosphere, nominally at an altitude of 200 kilometers) was developed. The start of this check at DSS 14 and 43 is coincidental with the time at which the station configuration is finally frozen (i.e., no further rectification of hardware failures). The

check consists of a switch-by-switch "preflight" followed by acquisition of the bus downlink signal by the five closed loop receivers and five open loop receivers. This signal is processed by the four (closed loop receiver) telemetry strings and routed via HSDL to JPL for verification (see Fig. 1). Simultaneously, the closed loop receiver doppler is processed and transmitted to JPL and the four open loop receivers and Multi Mission Receiver (MMR) similarly acquire the bus signal, confirmed on the Spectral Signal Indicators (SSIs), and record the open loop doppler and telemetry on the DRA and PPR recorders. The open loop signal recorded on the PPR recorders is replayed via the up-converter into the closed loop receivers and again routed back to JPL. This positively confirms correct configuration of all the closed and open loop data paths. Finally, the checklist requires the termination of the bus signal tracking and all other signal sources, the loading of new tapes, and the loading of all required probe parameters and frequencies, etc.

- (3) The E-1 hour checklist is virtually a final recheck of switch positions and frequencies prior to probe acquisition.
- (4) These procedures plus the extensive multiprobe encounter prepass calibrations will be exercised in tests starting in July 1978 and continuing every other week to December 1978, specifically involving the station crews who will be supporting the actual encounter.

The initial exercises at DSS 14 in March indicated that a 16-man crew is required to operate at DSS 14 and DSS 43 during the encounter, so the above tests are planned at a time when the prime crews are "back to back," enabling both crews to work an extra four hours in parallel along with the off shift personnel needed to produce the full complement of 16.

C. ALSEP Tracks

The ALSEP tracks are being executed to produce VLBI data in order to check out the VLBI Wind Measurement experiment which involves station equipment, CTA-21 processing and MIT processing. The tracks involve various combinations of DSS 14, 43, and STDN Santiago and Guam tracking stations. This series of test tracks was described in *The DSN Progress Report 42-45*; and the next article in this series will include a detailed status of the results of the tests conducted from February through July 1978.

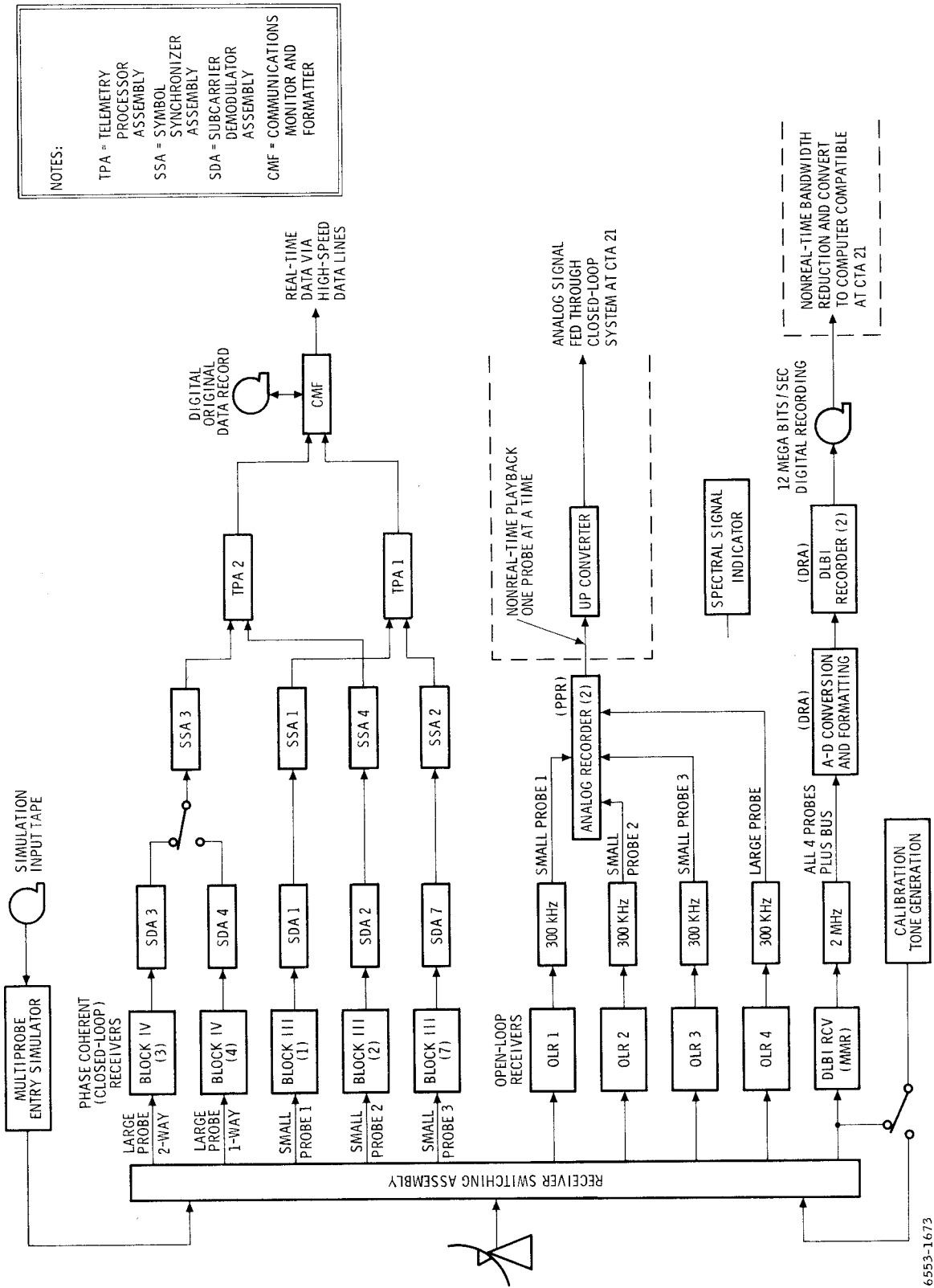


Fig. 1. Pioneer Venus '78 multiprobe entry